Obtaining and Submitting NEO Observations to the MPC: How and Why

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Background Information and Outline

---The Minor Planet Center (MPC): Charter and responsibilities

---Near-Earth Objects (NEOs): definitions and background

--Astrometry for orbit improvement--quality and volume requirements

--What we need and don't need going forward

--How the MPC can help observing programs

MPC Roles and Responsibilities

The MPC is the world's nerve center for minor planet and comet observations.

The MPC collects, processes, distributes all positional measurements, orbits, and discovery information for all minor planets and comets (and some satellites of planets as well)

We alert the world of impending impacts

We help coordinate worldwide observers

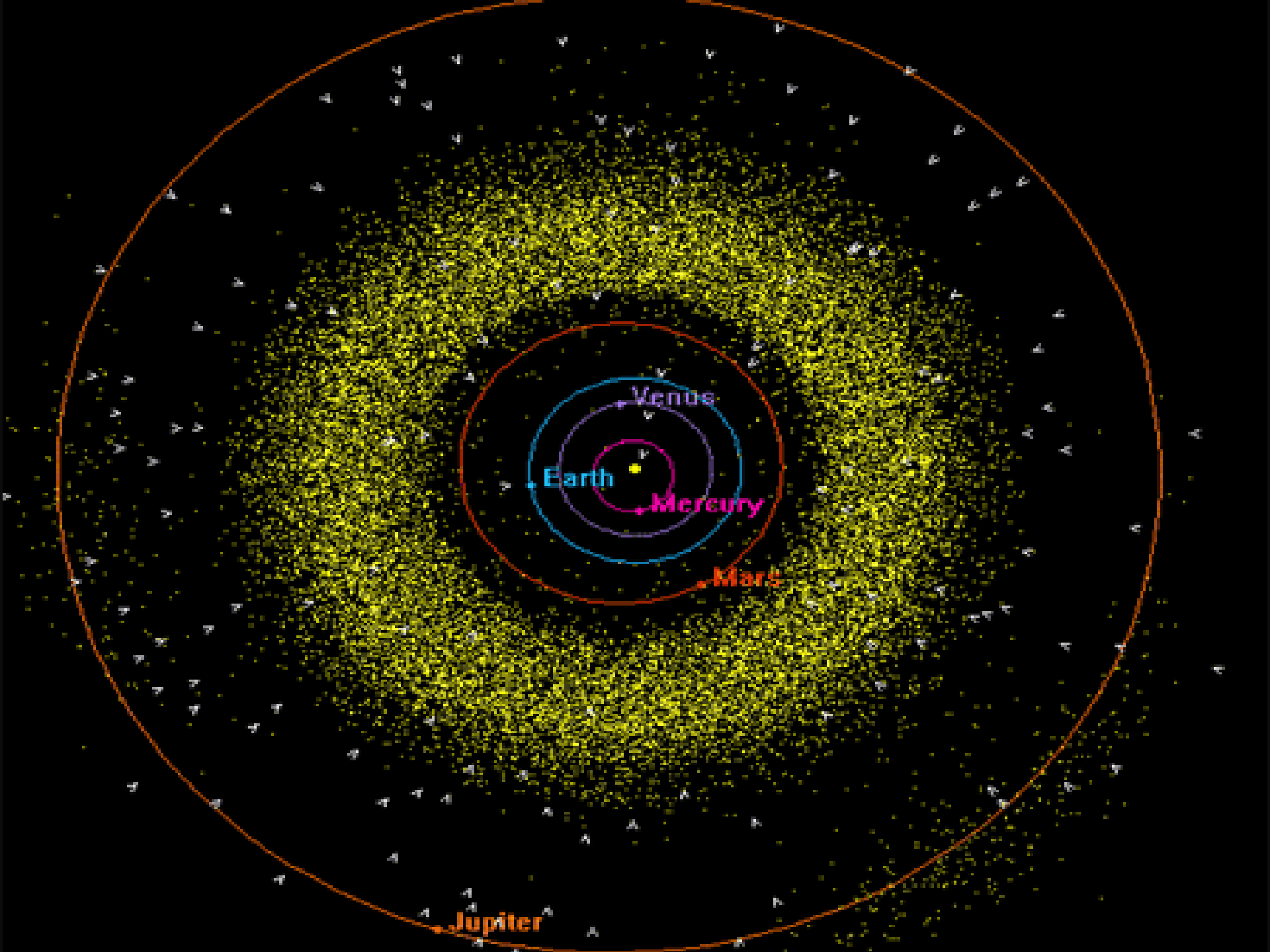
What is a Near-Earth Object or NEO?

--NEOs are solar system objects (Minor Planets) that can pass close to the Earth

--Formal definition: perihelion $q < 1.3$ AU

--Nearly all NEOs orbit the same direction as the planets and other asteroids; they are just leftovers from collisions of other minor planets

--Around 1000 NEOs known to 1-km diamater. Many millions of smaller objects. Ongoing need for discovery and monitoring

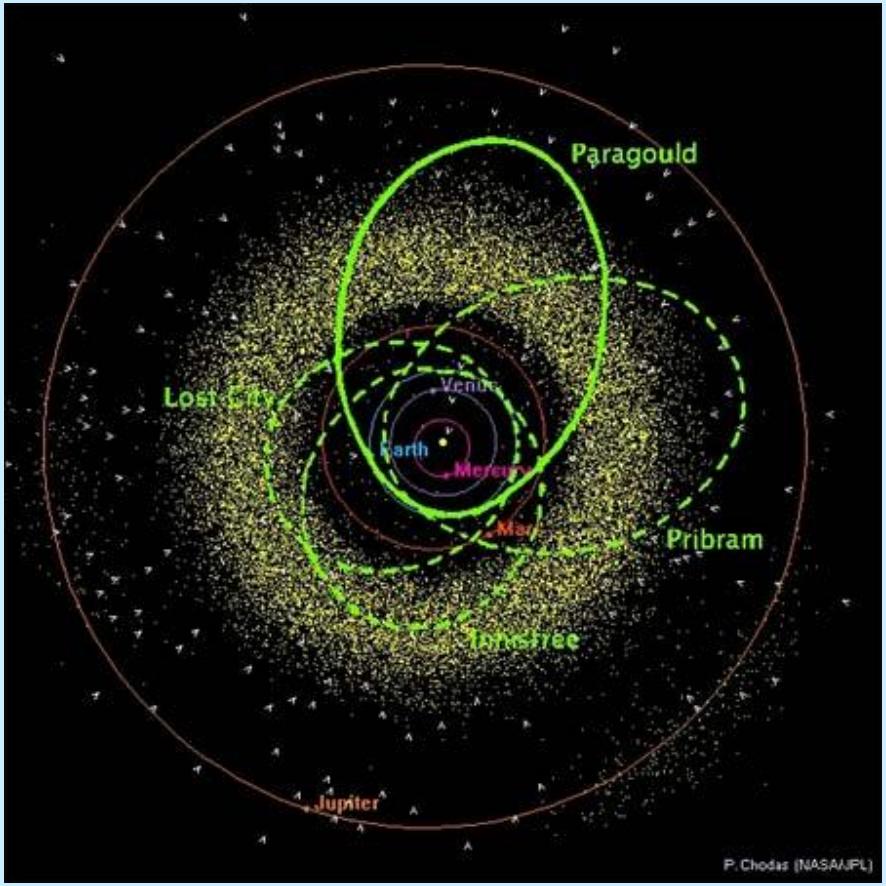

Venus
Earth
Mercury
Mars
Jupiter

Why observe NEOs?

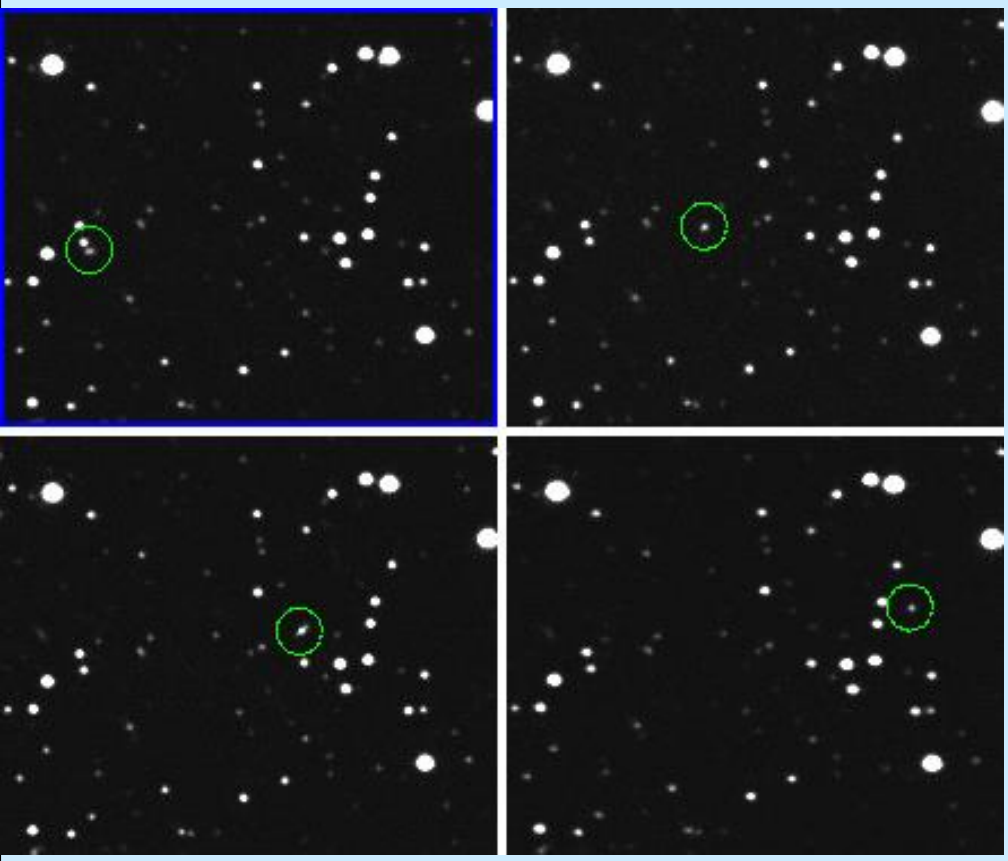
--The MPC uses high-precision astrometric observations for orbit calculations

--Long-arc observations help us improve orbit predictions

--Monitor for possible impacts; physical observations, (radar, spectra)



Astrometric observations: What and How?



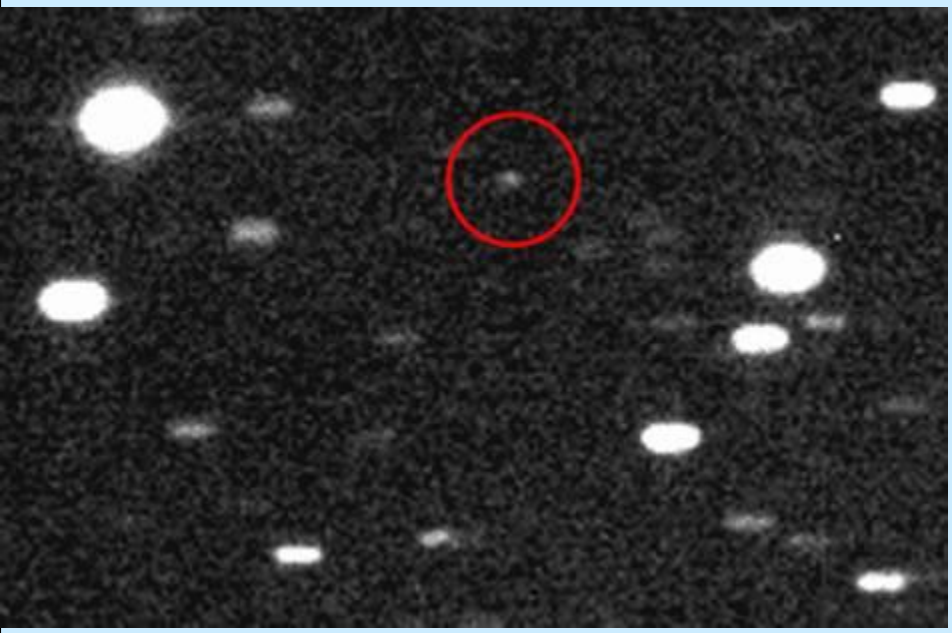
Match stars to hi-precision catalog (UCAC, PPMXL, etc)

Least-squares solution to map pixel coordinates to RA & DEC

Use centroided asteroid position to get RA & DEC

Use midpoint of exposure for precise time!

Astrometric observations: continued



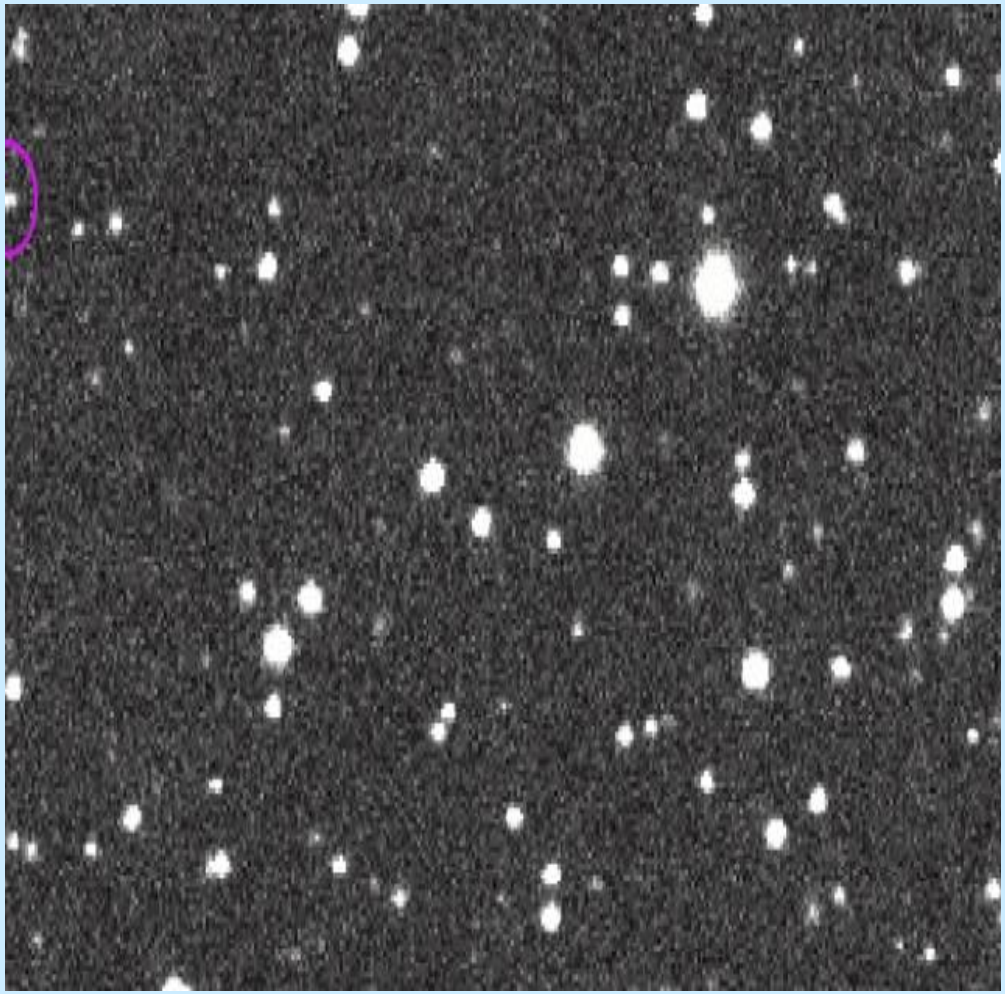
Astrometrica works very well! Many pros use it.

Finer points—always obtain 2 (preferably 4!) observations of each object, generally over 30-min interval

Never submit just one.

May track on asteroid to Improve SNR

Astrometric observations: pitfalls



Clock not set to universal time to nearest second

Not measuring midpoint of exposure

Bad astrometric solution

Failure to dither telescope between exposures and measuring flat-field defects

Many others!

The Rewards!

M.P.E.C. 1996-K01 Issued 1996 May 16, 22:59 UT

The Minor Planet Electronic Circulars contain information on unusual minor planets and routine data on comets. They are published on behalf of Commission 20 of the International Astronomical Union by the Minor Planet Center, Smithsonian Astrophysical Observatory, Cambridge, MA 02138, U.S.A.

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1996 JA1

Observations:

J96J01A*I	1996	05	14.35091	15	48	36.15	+16	49	34.0	16.5 V 693
J96J01A	1996	05	14.36925	15	48	32.96	+16	49	34.0	693
J96J01A	1996	05	16.21042	15	42	51.45	+16	48	17.4	14 V 693
J96J01A	1996	05	16.22095	15	42	47.88	+16	48	16.5	693
J96J01A	C1996	05	16.26477	15	42	31.50	+16	48	16.9	15.1 R 691
J96J01A	C1996	05	16.26895	15	42	30.00	+16	48	17.2	15.4 R 691
J96J01A	C1996	05	16.27398	15	42	28.08	+16	48	16.9	691
J96J01A	C1996	05	16.28023	15	42	25.71	+16	48	16.2	691
J96J01A	1996	05	16.31087	15	42	13.81	+16	48	09.8	693
J96J01A	1996	05	16.41015	15	41	34.54	+16	47	40.6	693
J96J01A	C1996	05	16.91436	15	38	29.75	+16	44	21.5	15.1 R 046
J96J01A	C1996	05	16.91601	15	38	28.87	+16	44	21.1	046
J96J01A	C1996	05	16.91686	15	38	28.42	+16	44	20.6	046
J96J01A	C1996	05	16.91881	15	38	27.39	+16	44	20.1	046

Observer details:

046 Klet. Observers J. Ticha, M. Tichy, Z. Moravec. 0.57-m f/5.2 reflector.

691 Steward Observatory, Kitt Peak. Observers C. W. Hergenrother, S. M. Larson, V. Hansen. Measurers C. W. Hergenrother, J. V. Scotti. 2.3-m f/2 reflector.

693 Catalina Station, Tucson. Observers C. W. Hergenrother, T. Spahr. Measurer T. Spahr (discoverer). 0.41-m f/3 Schmidt.

Orbital elements:

1996 JA1

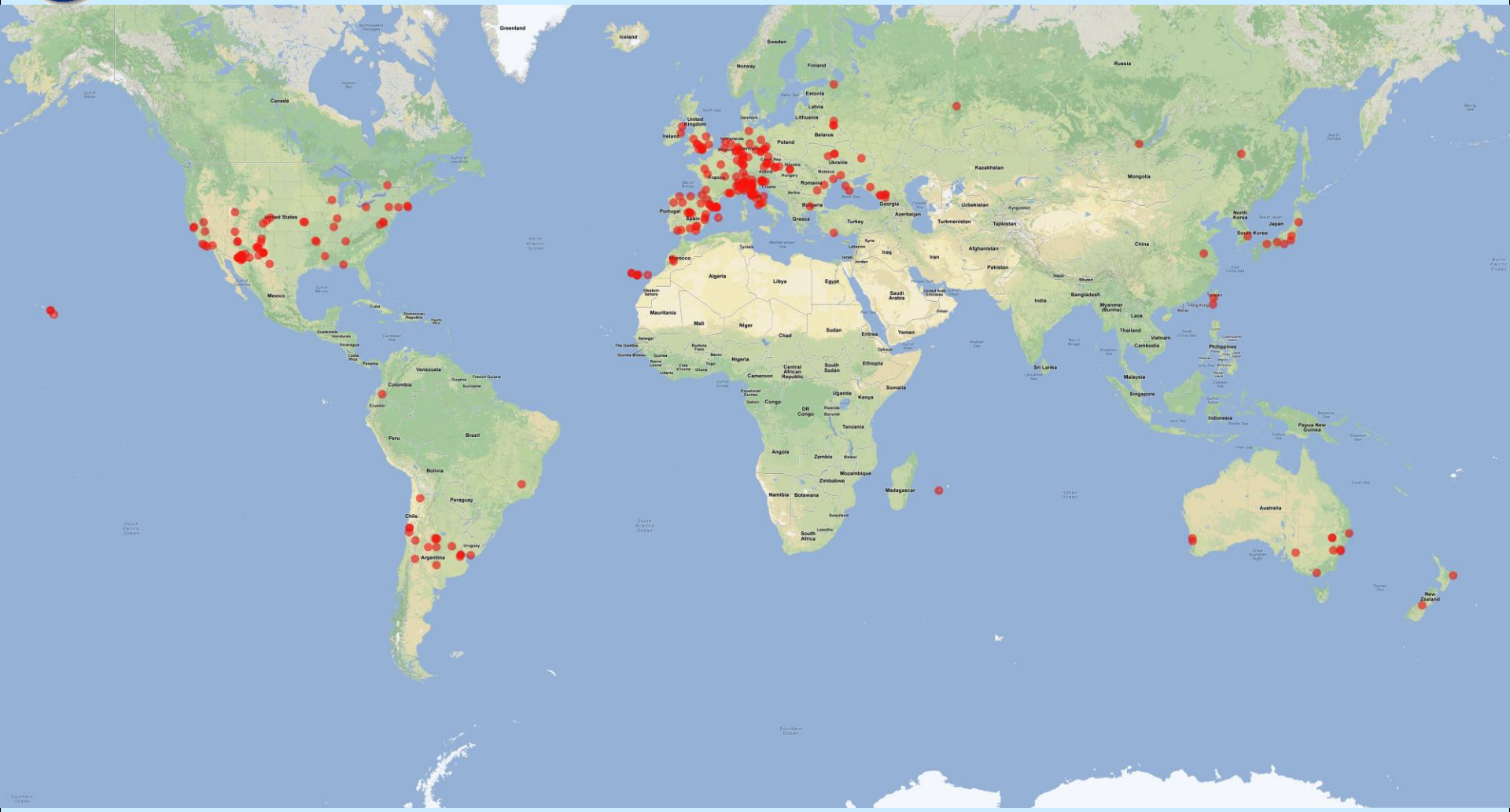
Epoch 1996 Apr. 27.0 TT = JDT 2450200.5 Marsden

M	344.09901	(2000.0)	P	Q	
n	0.24592611	Peri.	245.94759	+0.51172785	+0.79630616
a	2.5230912	Node	58.76165	-0.58509259	+0.59791046
e	0.6960932	Incl.	22.16223	-0.62912738	+0.09164927
P	4.01	H	20.5	G 0.15	U 8

From 12 observations 1996 May 14-16, mean residual 0".43.

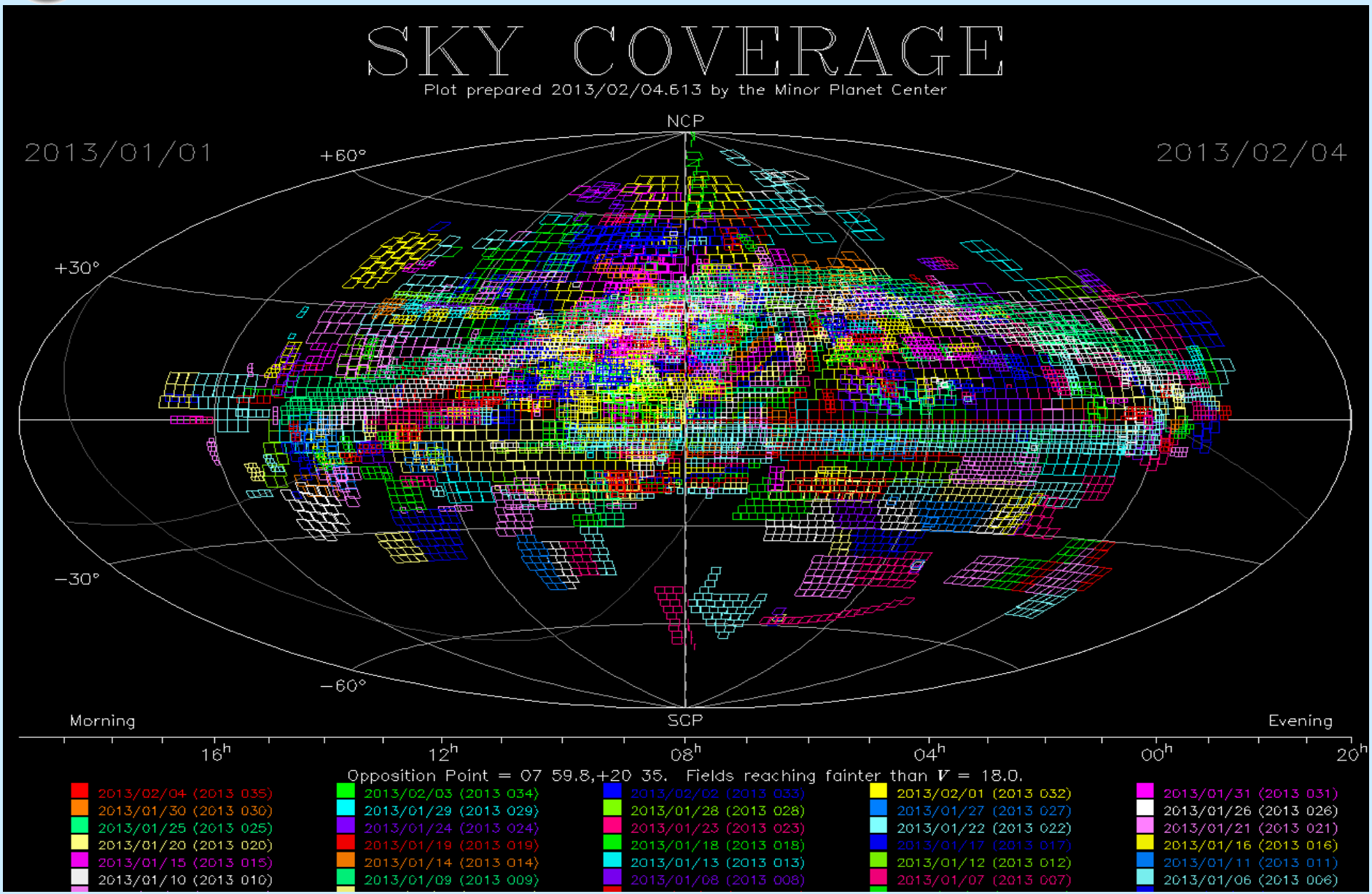
Ephemeris:

Existing Worldwide Observing Network



South Africa important in terms of geometry!

Monthly Sky Coverage



Survey and Follow-up Needs

--You're in a great location!

--Astrometric monitoring of new NEOs found from US

--Monitoring of objects at large southern declinations

--Faint follow-up of V = 20-22 NEOs

--Discovery system? Survey nightly to V > 21?

Needs quantified

--follow-up of hundreds of objects per month to V > 20 would be ideal

--follow-up of a few dozen V > 22 objects monthly would be outstanding

--specific targeting of objects visible only from your latitude

--Discovery system? 1000 square degrees nightly to V > 21?

(IAWN) “Needs List”

Dedicated groundbased telescopes capable of surveying to V > 22

Dedicated groundbased telescopes for astrometric and physical observation follow-up to V > 22

Survey cooperation and collaboration

International communication and public relations with respect to potential impacts and their consequences

What we don't need…

More groundbased telescopes that can only observe small patches of sky to V < 20

Poor-quality groundbased follow-up of NEOs to V ~ 19-20

The reason is that much of this is done by the survey telescopes now, at least in the northern hemisphere

The Minor Planet Center—help & info

http://www.minorplanetcenter.net/

Near-Earth Object Confirmation Page

NEOCP Blog

Alert System (to MPC staff, JPL, NASA, then to public)

MPC has observers on staff, some which ran survey and follow-up programs

The Minor Planet Center--communication

http://www.minorplanetcenter.net/
Near-Earth Object Confirmation Page
NEOCP Blog
Twitter, Facebook

Alert System (to MPC staff, JPL, NASA, then to public)

Relational Database
http://www.minorplanetcenter.net/db_search

Directed Communication (observation requests & pleas)

Summary & Conclusions

--South Africa well-placed in terms of latitude and longitude for contribution to NEO efforts

--Continued monitoring of NEOs necessary

--Astrometry helps improve orbits for objects that are not observed elsewhere

--Surveying for NEOs from southern skies to V > 21-22 necessary

The MPC will help coordinate observations